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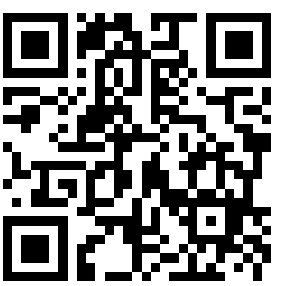

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REPORTS OF THE RESULTS

OF AN

EXAMINATION,

BY THE OFFICERS OF

H.M.S. "RAMBLER,"

OF THE

SLOPES AND ZOOLOGICAL CONDITION

OF

TIZARD AND MACCLESFIELD BANKS,

1888.

By Commander W. U. MOORE, R.N.,

AND

P. W. BASSETT-SMITH, Esq., Surgeon, R.N.

H.D.106

Hydrographic Department,
Admiralty,
March 1889.

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VISIT TO TIZARD BANK.

BEARINGS GIVEN ARE MAGNETIC.

H.M.S. "RAMBLER,"
HONG KONG,
No. 15. 1*st May* 1888.

SIR,

I have the honour to inform you that last month I visited Tizard bank in Her Majesty's ship under my command, and spent six days on it, obtaining sections and specimens of the bottom, in accordance with the desire expressed in your communication of 17th January.

We arrived on the morning of Sunday, 15th April, and moored in six fathoms, coral bottom, 1320 yards, N. 34° W. from the west extreme of the Sand cay. In the afternoon a landing was effected on the cay, which is now covered with bushes and 15 feet high, the height of the bushes being 9 feet. The reef around it is principally covered with live coral; but on the north side there is a great deal of dead coral and sand, especially at the outer edge. A few specimens were collected on the reef. The duties for the ensuing week were allotted; one steam cutter being detailed for the soundings on the section line; the other for dredging both on the section lines and at other places, to ascertain the nature of the bottom and collect specimens. The Surgeon, Mr. P Bassett-Smith, who has employed much of his leisure time in studying corals, undertook to arrange the specimens, and furnish a separate report on them, which I have now the honour to forward, observing that I am indebted to this officer for the trouble he has taken in the matter; Mr. Bassett-Smith usually accompanied the dredging boat.

The diver, during our stay on the bank, collected specimens of the bottom from under the ship, and from the outer edges of the reefs where the surf might be expected to be most violent.

The sections, in every case, were run through the ship, moored taut without a swivel. This I considered sufficiently accurate, as the height of the truck above the upper white stripe is 91 feet, and the subtending angle is sensitive as far as one mile from the ship. A boat, with flag on her mast, was anchored on the bearing selected for the section, to ensure the sounding boat keeping a straight line. The officers running the sections were furnished with instructions as to the distance apart of the soundings, and directed specially to look out for submarine cliffs, to note the nature of the bottom at every cast, and to retain a specimen in the case of one cast over 100 fathoms.

Under 100 fathoms, the bottling and preserving of specimens was the special care of the dredging boat.

The dredging boat was supplied with dredge, swabs and cup leads. On some occasions the dredge and swabs were used together as in the "Challenger" (p. 74 Fig. 19. Vol. I. Narrative); on others the swabs were used on a bar without the dredge. The Lieutenant in charge of this duty was instructed to determine the position of every cast, and not to seek for a new specimen until he had labelled the one in hand with the alphabetical letter of the section, the number of the specimen, the sounding and the masthead angle.

Special attention was directed to the examination of the outer edge of the elevated rim of the bank, the inner edge of the same, and the outer slope between the edge of the rim and a depth of 40 fathoms.

The first section (A) was commenced at 7 a.m. on the 16th April, and occupied the whole day. It was run in a direction N. 8° W., and S. 8° E., from 424 fathoms on the outer slope, to 26 fathoms in the lagoon, passing over the west extreme of the reef around Sand cay. The dredging cutter, after

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examining the outer slope and the elevated rim, swept the floor of the lagoon south of Sand cay. The diver brought up many specimens of the bottom from under the ship.

At 5.30 a.m. on the 17th, I proceeded to the north-east point of Eldad reef, and moored in 7 fathoms, coral bottom, 560 yards N. 30° E. from the extreme. Section (B) was run in a direction N. 50° E., continuing under water the general direction adopted by that part of the reef which was awash, from the reef to a depth of 154 fathoms. The dredging boat, as before, examined the slope. The diver sought for specimens in a depth which would reduce to 3 feet, at low water spring tides, off the extremity of the reef, and brought up several specimens, one particularly noticeable.

These two sections (A) and (B) showed that there was a steep declivity on the outer slope between 9 and 30 fathoms. Coral in vigorous growth was found on the top of this slope and some distance down ; but only in small fragments at the bottom. From this time, the dredging boat spent most of her time in sweeping between the depths of 20 to 50 fathoms, the officers rigorously examining the swabs for live coral.

At 2 p.m. on 17th I proceeded to Nam Yit, and failing to find a secure anchorage off the eastern point of the reef around the island, moored in five fathoms on a bank, 2,020 yards N. 30° E. from the east extreme of the island. Between this bank and the reef around Nam Yit the sunken barrier is interrupted, and there is a channel into the lagoon.

Section C was run on the 18th in a direction S. 40° E., and N. 40° W., from 338 fathoms on the outer slope to 24 fathoms in the lagoon. Its conditions differ from A and B in two particulars. In no part does it approach the water line closer than 5 fathoms ; and it is separated by a lagoon channel from the nearest reef awash. The declivity, before remarked upon, does not appear in this section, but there is a remarkable cliff at 57 fathoms, the ground falling to 110 fathoms in a distance of 20 yards.

The diver obtained some specimens of the bottom from under the ship, and some from a depth of 10 feet (reduced to low water springs) within a few yards of the breakers on the east extreme of the reef surrounding Nam Yit. The Surgeon landed on Nam Yit. He found the surrounding reef to be formed almost entirely of dead coral.

At 2.30 p.m. on the 18th I proceeded to Gaven reefs, and moored 300 yards W.N.W. from the north extreme of the South Gaven reef in 7 fathoms, coral bottom. Section D was run on the 19th, from 14 fathoms on the inner slope of the reef passing 200 yards north of the South Gaven reef, in a west direction through the ship, to 300 fathoms on the outer slope. You will observe, sir, that this section in no part comes within 5 fathoms of the surface, but is very close to a reef awash, cutting across its northern slope ; and that it has the same declivity in moderate depths as sections A and B, though not so pronounced. There is a steep fall between 48 and 127 fathoms, the ground being hard in one spot, breaking the point of a 112-lb. cup lead without returning anything in the cup.

The outer slope, below 20 fathoms, was swept for live coral with small dredge and swabs without success, and the dredging boat examined the bottom in the passage which leads north of the South Gaven reef into the lagoon, finding sand and a small quantity of dead coral.

The diver brought up some specimens from a depth of 10 to 12 feet, a few yards from the west and south-west extremes of the South Gaven reef, where there must be heavy breakers during the south-west monsoon.

At 2 p.m. on the 19th I proceeded into the lagoon to make an examination of one of the banks, and directed the dredging boat to proceed to the deepest water she could find in the western part of the lagoon, and try one haul of the dredge, while the section boat ran a line east and west through the ship, moored on the bank selected for examination.

Lieutenant Parry and Doctor Bassett-Smith, in the dredging boat, were rewarded for their labours by discovering a fragment of astræa alive at a depth of 45 fathoms, amongst fine green sand. It was brought up in a swab, having been, to all appearance, broken off from a lump by the sharp mouth of the dredge, the dredge being half full of the sand mentioned. The Surgeon brought it on board alive in a bottle of sea water, to show me before killing it, which he

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did, by corrosive sublimate, in so instantaneous a manner as to prevent the polyps retiring as usual into their cells.

As I conceive it to be possible that this specimen (No. 39) may be received with some incredulity by those beyond your office who are unaware of the precautions which are taken on board H.M. surveying ships to ensure accuracy in such matters, it may be as well to mention that the dredging which resulted in the discovery of this coral was the *sole cast of the afternoon*, and that the swab had *not been used before on that day*. The vital importance of guarding against any chance of confusion in the arrangement of specimens in the boat was fully appreciated by the surveying officer who conducted the dredging.

The bank on which the "Rambler" was moored bore N. 1° E., distant 3·7 miles from the north extreme of Nam Yit. It was composed chiefly of dead coral. The diver had difficulty in finding specimens of live coral upon it; and reported that the bottom under the ship was entirely different to what he had seen at the other anchorages.

Section E was run through the ship in an east and west direction for 1,160 yards on either side, the soundings being taken on the evening of the 19th and the morning of the 20th. At 10 a.m. on the 20th April, I proceeded to Itu Aba, and moored 900 yards S. 81° W. from the south-west extreme of the island.

Section F was run through the ship in a direction N. 65° W. and S. 65° E., from 31 fathoms in the lagoon to 270 fathoms on the outer slope, and passed within a few yards of the south-western extreme of the reef surrounding the island of Itu Aba.

The dredging boat swept the slope below 20 fathoms, and found very little live coral. The diver went down under the ship, and reported that this part of the rim was chiefly composed of dead coral. There were tufts of living coral about, specimens of which are forwarded. He also obtained some specimens from the south edge of the reef around Itu Aba.

On the 21st April the section was completed, and the dredging boat examined the inner edge of the elevated rim, finding live coral; and obtained a dredging in 41 fathoms in the lagoon 1 to 2 miles south-east of Itu Aba. The diver on this day searched the west and north edges of the reef around the island in from 4 to 9 feet (reduced to low water spring tides) and brought up a few specimens. The principal portion of this reef, however, is dead. There are patches of living coral upon it, but they are wide apart. It has a very different appearance to either Sand cay reef, Eldad reef, Gaven reef, or that portion of Nam Yit reef which is below low water level. The north part of it is composed of tongues of coral lime stone jutting out in a north and south direction, with fissures between having a floor of sand.

As much time had now been spent on Tizard bank as the service permitted, considering the amount of work to be completed before the end of the ship's commission, more immediately affecting hydrographic interests; and at 3 p.m. I proceeded on a course for Hong Kong. The sections which I have the honour to submit to you will speak for themselves, and but few remarks on them are necessary. Where a dredging has taken place on the line of section, it is registered in the drawing with the number of the specimen; where it has been obtained off the line of section, it is noted with its proper number on the enlarged plan at the head of the sheet. The bottom, as given on the sections, is from the actual material brought up by the sounding lead; and is sometimes deceptive, for the pieces of dead coral easily adhere to the tallow, whereas the hard living coral is not often broken off.

Briefly, the result of our five days' examination of the Tizard bank may be stated as follows:—

Live coral exists over the whole of the elevated rim, but is more luxuriant on the south-west part than elsewhere.

At the north-west part of the bank where the land is oldest, coral has ceased to grow on the outer slope, and on the outer part of the reef around that land.

The slope of the bank is far more steep on the south and south-west part than on the north-west, north, and north-east.

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Live coral in blocks, and of more or less vigorous growth, was found as far as a depth of 13 fathoms; and in small fragments as far down the slope as 32 fathoms. At greater depths than this, we have no evidence of live coral on the outer slope of this bank. It should, however, be noted that the dredge and swabs, the best means at our disposal, might drag over low blocks of astræa or porites without detaching pieces; and this being the case, we have no absolute proof that the smooth species of reef-building corals do not exist below 32 fathoms, though, judging by the numerous specimens of dead coral and of sand brought up from greater depths on the slope, the chances are against it.

A specimen of astræa alive was found in one of the deepest parts of the lagoon at a depth of 45 fathoms, amongst fine green sand.

Where the section was through a part of the elevated rim which reached to the surface of the water, or where it was near such a part (as in D), a steep declivity was found somewhere on the slope between 7 and 30 fathoms.

The lagoon banks are apparently crowned with dead coral, and the floor of the lagoon is covered with sand.

The inner slope of the elevated rim is very gradual.

The weather being fine when we approached the Macclesfield bank on our passage north, I moored upon the south-western part of the elevated rim in 16 fathoms, coral bottom, at 8 a.m., 23rd April, in latitude 15° 29′ 11″ N., longitude 113° 52′ 40″ E.; and a section was run through the ship in a N. 21° E. and S. 21° W. direction, from 14 fathoms near the ship to 686 fathoms on the outer slope. Dredging operations, specially with a view to discovering the nature of the bottom on the elevated rim and outer slope, were carried on in one cutter throughout the day.

It was found that the rim at this part was covered with a mixture of live and dead coral. Coral was found living as far down the slope as 44 fathoms; it may extend further, but darkness put an end to the work. A 8 p.m. I left for Hong Kong.

The section is somewhat remarkable; it has a point of similarity with section C of Tizard bank. There is no steep declivity at a moderate depth, but there is an extraordinary drop between 65 and 115 fathoms.

The specimens from Macclesfield are marked "Macclesfield," to distinguish them from those from Tizard bank upon which there is no name. The M.H.A (masthead angle), in both cases, is a check for future reference at the Hydrographic Office, should it be required to establish the fidelity of a number.

I have the honour to be, Sir,

Your most obedient Servant,

W. USBORNE MOORE,

Commander.

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REPORT

OF

TIZARD AND MACCLESFIELD BANKS.

H.M.S. "RAMBLER,"
HONG KONG,
29th April 1888.

Having been requested by Captain Moore to make a report of my observations during the survey of the Tizard and Macclesfield banks, I beg to forwarded the following report.

But first, I wish to express my thanks to Captain Moore, for the great facilities that he gave me in every way for collecting specimens and obtaining observations, and also to Lieutenant J. F. Parry, who had charge of the dredging cutter, and who rendered most valuable assistance in collecting and packing the specimens.

Specimens both alive and dead, of all the bottoms, were carefully recorded and kept, and when living coral, or any other object likely to be of scientific value, was brought up from any depth a portion was always preserved in spirit for more careful examination. Every endeavour has been taken to make the work as thorough as possible.

Besides the examination of the bottom, especially the slope, where the line of demarcation between living and dead coral seemed to exist, the tow net was used at each anchorage, to throw some light, if possible, on the amount of food supply both in and outside the lagoon (the currents being observed from the ship) ; deep temperatures were taken, there being five degrees variation between that of the surface and the bottom at over 40 fathoms.

Sand cay and Nam Yit islands were visited, botanical and zoological specimens being collected from them, and photographs were taken at the latter place. Unfortunately no water could be obtained from the bottom of the lagoon for examination.

When working among luxuriously growing coral, a weight with swabs attached was found most effective, a light dredge, with swabs at the base, being used in deeper water, with weight and line according to depth, declivity, and current, the swab often picking up what had been knocked off by the chain and dredge.

I will first give in detail the results of the dredging, &c., on the various sections of the Tizard reef, giving the number which is attached to the specimen, the distance from the ship, with bearing if off the section ; then an account of the island, &c., and afterwards the observations taken on the Macclesfield bank.*

SECTION A.

No. 1.—DEPTH, 30 FATHOMS.

Distance from the ship, 200 yards.
Cup lead brought up broken shell and small coral débris.
Dredge and one swab brought up :—
Large pieces of dead encrusted coral rock,

* N.B.—The bearings are magnetic, and from the boat.—W. U. M.

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One dead fungia, a few dead shells,
Coral rock covered by serpulæ hydroids,
Tunicata and algæ,
Several ophiuroids alive,
And a few tops of madrepore alive.

No. 2.—Depth, 22½ Fathoms.

Distance from the ship, 176 yards.
The dredge, with two swabs attached, was put over just outside the edge of the reef; these brought up :—
Dead coral rock as before plentiful,
And a few fragments of live madrepore.

No. 3.—Depth, 6 Fathoms.

On the top of the reef, near the edge, swab brought up living coral with bifid ends,
Oculina ?
Comatulæ alcyonarians and sponges.

No. 4.—Depth, 33 Fathoms.

Distance from ship, 206 yards.
Cup lead brought up sand, small broken dead coral and foraminifera tests.

No. 5.—Depth, 51 Fathoms.

Distance from ship, 314 yards.
Cup lead brought up fine sand.

No. 6.—Depth, 85 Fathoms.

Distance from the ship, 512 yards.
Cup lead showed hard bottom.

No. 7.—Depth, 35 Fathoms.

Distance from the ship, 266 yards.
Cup lead came up filled with small coral débris.
Dredge and swabs using a 50-lb. weight, brought up :—
Quantities of dead encrusted coral rock with hydroids, serpulæ, &c., several dead shells, living asteroids, tunicata, and sponges both horny and calcareous.

No. 8.—Depth, 5¾ Fathoms.

688 yards inside the ship.
Swabs only used; these brought up :—
One large madrepore alive,
One oculina (as No. 3) alive,
Alcyonoids, comatulæ, and one small octopus.

No. 9.—Depth, 27 Fathoms.

Inside the lagoon 2,200 yards from ship.
Cup lead came up full of fine white sand.

No. 10.—Depth, 31 Fathoms.

Inside the lagoon 2,600 yards.
Cup lead brought up fine white sand.

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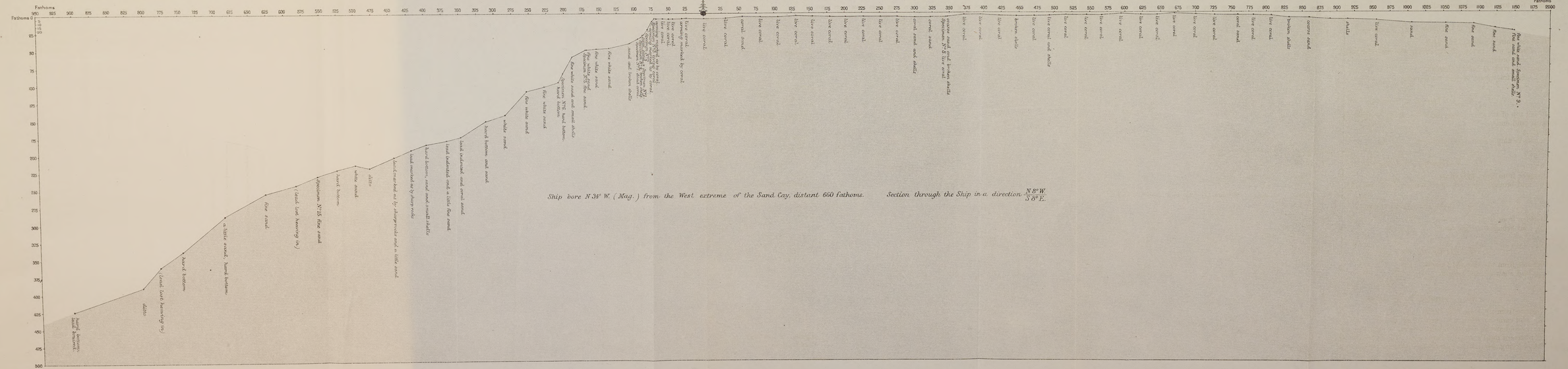
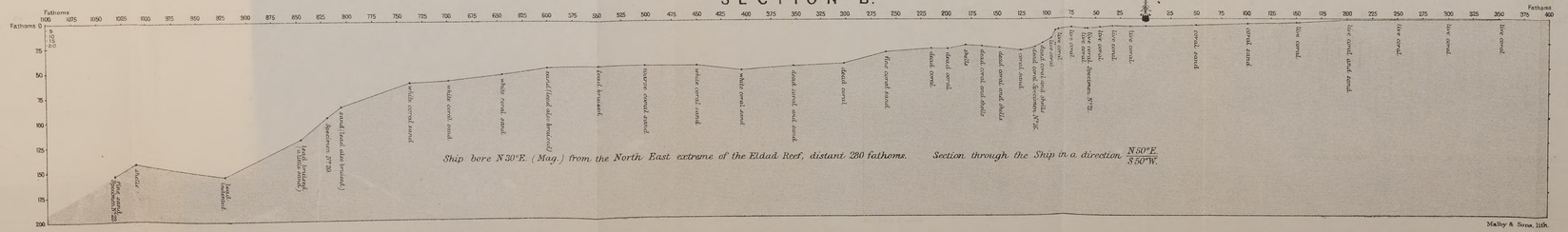
TIZARD BANK.

SECTION A.

The nature of the bottom as given in these sections is from the actual material brought up by the sounding lead.



SECTION B.



Malby & Sons, lith.

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No. 11.—Depth, 32 Fathoms.

Inside the lagoon 3,400 yards from ship.
Cup lead brought up small coral débris and fine sand.

No. 12.—Depth, 34 Fathoms.

Inside lagoon 3,040 yards from the ship, bearing N. 29° W.
Cup lead brought up fine white sand. Here the temperature of the bottom was taken, and found to be 79°5, surface 8°45.

No. 13.—Depth, 6½ Fathoms.

On the inner reef of Sand cay.
Patches of coral with lanes of white sand plainly visible.
Swabs brought up:—

One large flat meandrina,
One large madrepore,
One fine oculina ?
One piece of porites, all living.

No. 14.—Depth, 8½ Fathoms.

Inside lagoon 2,260 yards from the ship, bearing N. 31° W.
Swabs brought up:—

Madrepores of several varieties alive,
One comatula and many curious crabs.

No. 15.—Depth, 232 Fathoms.

Distance from the ship, 1,110 yards.
Cup lead brought up fine white sand.

SECTION B.

No. 16.—Depth, 27 Fathoms.

Distance from the ship, 180 yards ?
Just over the edge of the reef as before, which is plainly visible, the cup lead gave small pieces of dead coral.
Swabs used brought up:—

Few tops of live madrepore,
One small piece of porites alive,
Quantities of dead encrusted coral rock,
Numbers of alcyonoids, asteroids and crabs,
Small pieces of delicate dead leaf-shape corals.

No. 17.—Depth, 43 Fathoms.

Distance about 450 yards from ship.
Cup lead brought up dead coral and broken shell.
Swabs came up full of dead encrusted coral rock, numerous sponges, alcyonarians, and algæ, with one large comatulæ.

No. 18.—Depth, 57 Fathoms.

Distance, 820 yards from the ship.
Cup lead brought up small fragments of broken coral, dead.

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No. 19.—Depth, 59 Fathoms.

Distance 1,080 yards from ship.
Cup lead brought up coarse coral sand.

No. 20.—Depth, 96 Fathoms.

Distance 1,680 yards from ship.
Cup lead brought up coarse sand and broken shell.

No. 21.—Depth, 9½ Fathoms.

Distance 120 yards (about) from ship.
The swabs were let down and dragged off the reef.
Brought up:—
Lilac tipped madrepore,
Coarse madrepore,
And tubipora, all growing vigourously.

No. 22.—Depth, 5¾ Fathoms.

300 yards inside the ship between it and the breakers.
Several kinds of madrepores, oculinas, and porites were obtained.

No. 23.—Depth, 154 Fathoms.

Distance 2,064 yards outside the ship.
Cup lead brought up coarse sand with pteropod,
Shells, foraminifera tests, and spines of echini.

SECTION C.

No. 24.—Depth, 27 Fathoms.

Distance 1,020 yards from the ship.
No live corals brought up, but coral rock, quantities of horny alcyonoid tree corals, and soft leathery ones, numerous sponges, and algæ asteroids and echini, and comatulæ were obtained.

No. 25.—Depth, 27 Fathoms.

Distance 1,020 yards from ship.
The swabs brought up a beautiful specimen of fine branching cladocora ? with terminal polyps, alive, with quantities of dead coral rock encrusted with nullipora and algæ, besides several soft alcyonarians.

No. 26.—Depth, 43 Fathoms.

Distance from the ship, 1,120 yards
Swabs brought up dead encrusted coral rock, many sponges, alcyonarians and hydroids.

No. 27.—Depth, 50 Fathoms.

Distance 1,160 yards from ship.
A small quantity of dead coral rock,
One orange-colour winged murex (dead),
One imperator turbinidae dead),
And several simple corals (dead), sponges, and brittle stars were obtained.

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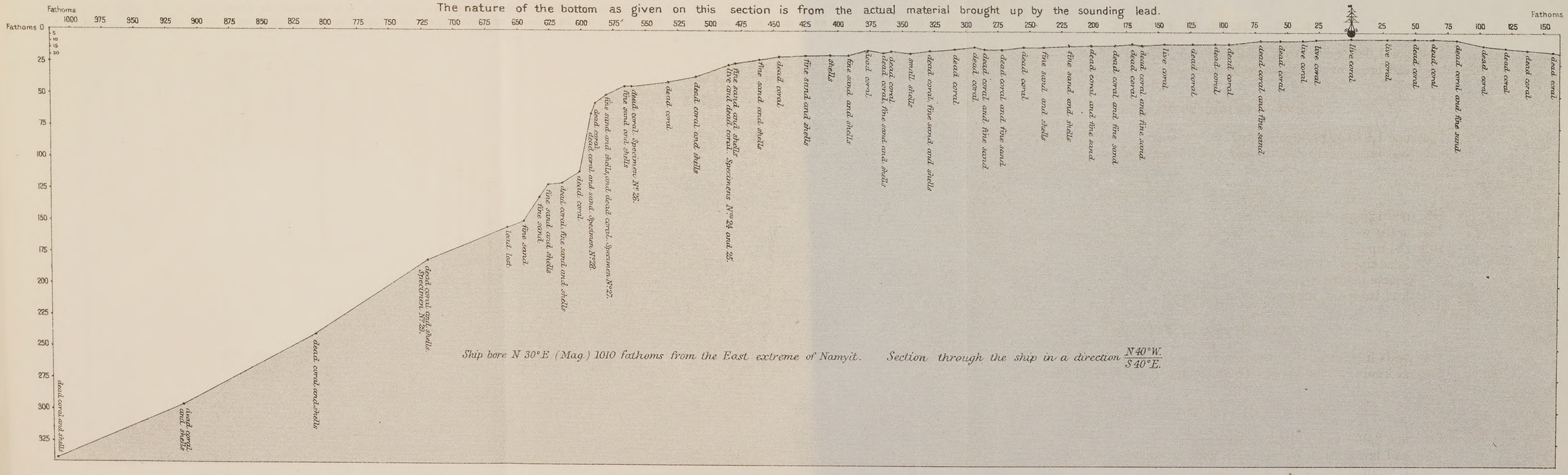
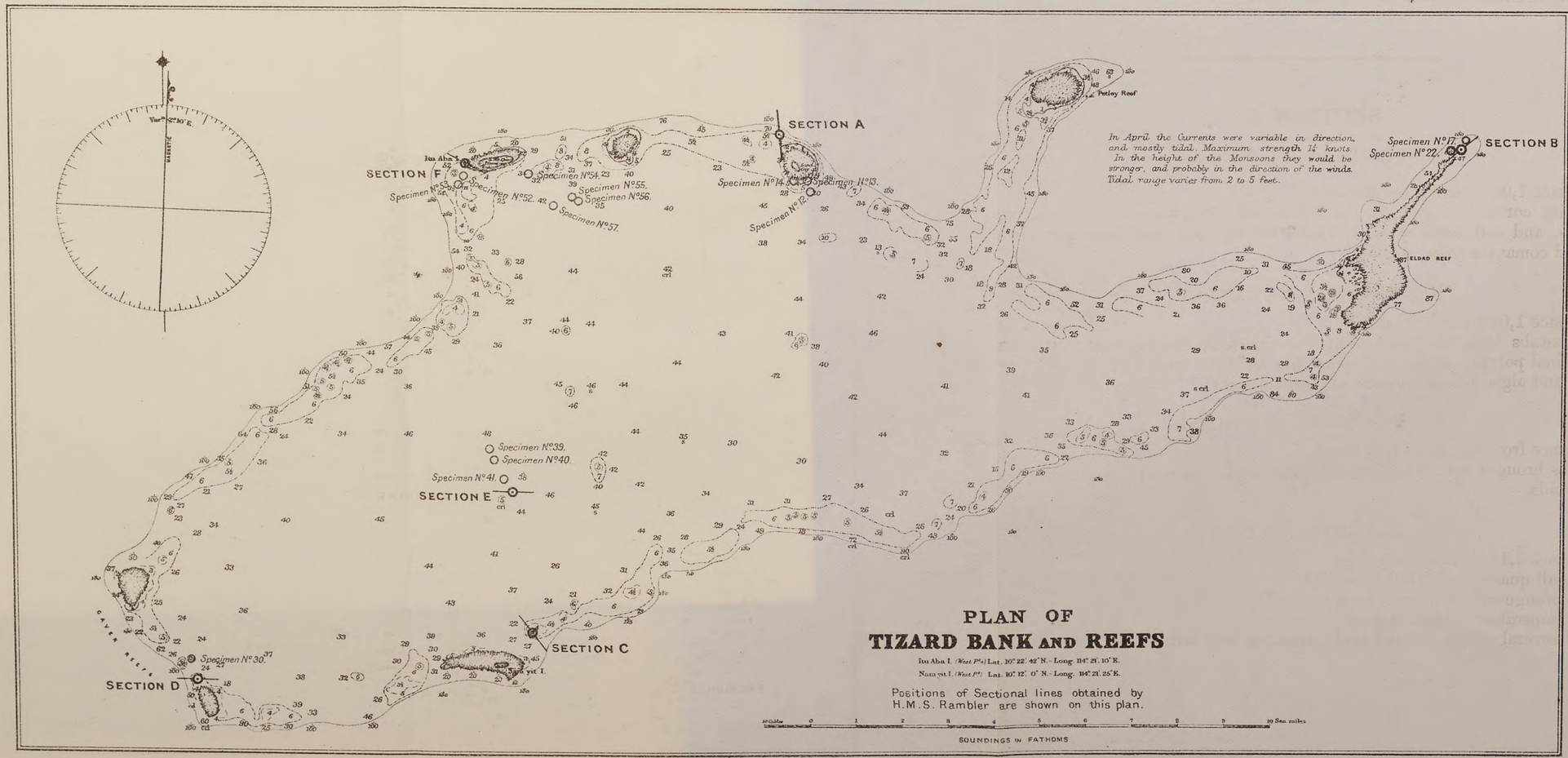
TIZARD BANK

SECTION C.

The nature of the bottom as given on this section is from the actual material brought up by the sounding lead.




SECTION A
SECTION B
SECTION C
SECTION D
SECTION E
SECTION F
Iku Aba I.
Petley Reef
ELDAD REEF
GAVEN REEFS
Specimen N°17.
Specimen N°22.
Specimen N°13.
Specimen N°14.
Specimen N°12.
Specimen N°54.
Specimen N°55.
Specimen N°56.
Specimen N°57.
Specimen N°52.
Specimen N°53.
Specimen N°39.
Specimen N°40.
Specimen N°41.
Specimen N°30.
In April the Currents were variable in direction, and mostly tidal. Maximum strength 1½ knots. In the height of the Monsoons they would be stronger, and probably in the direction of the winds. Tidal range varies from 2 to 5 feet.
PLAN OF
TIZARD BANK AND REEFS
Iku Aba I. (West Pt.) Lat. 10° 22' 42" N. - Long. 114° 21' 10" E.
Namyit I. (West Pt.) Lat. 10° 12' 0" N. - Long. 114° 21' 25" E.
Positions of Sectional lines obtained by H.M.S. Rambler are shown on this plan.
10 Cables 0 1 2 3 4 5 6 7 8 9 10 Sea miles
SOUNDINGS IN FATHOMS

Malby & Sons. lith.

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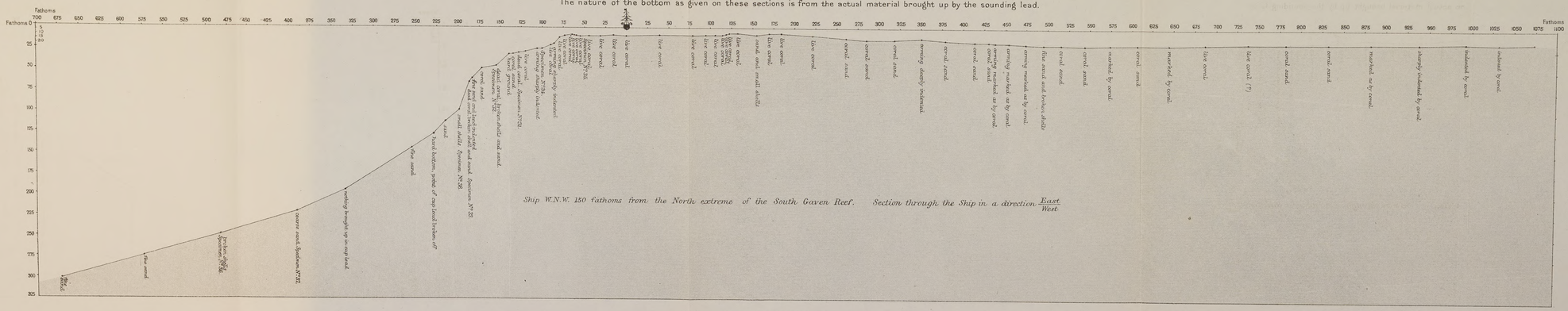
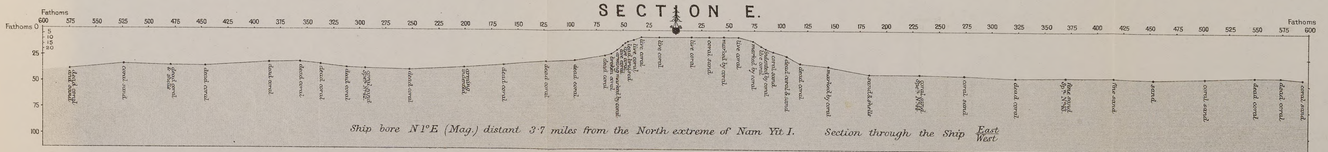
TIZARD BANK.

SECTION D.

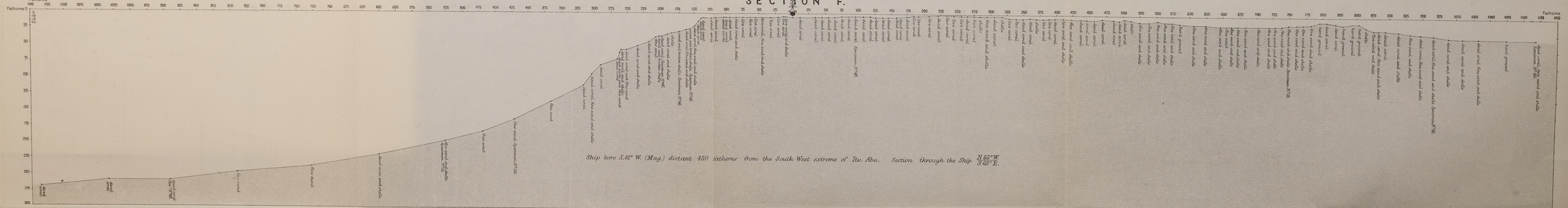
The nature of the bottom as given on these sections is from the actual material brought up by the sounding lead.


Fathoms
Fathoms 0
Ship W.N.W. 150 fathoms from the North extreme of the South Gaven Reef. Section through the Ship in a direction East / West.

SECTION E.


Fathoms
Fathoms 0
Ship bore N 1° E (Mag.) distant 3·7 miles from the North extreme of Nan Yit I. Section through the Ship East / West.

SECTION F.


Fathoms
Fathoms 0
Ship bore S.61° W. (Mag.) distant 450 fathoms from the South West extreme of Itu Aba. Section through the Ship N.65° W. / S.65° E.

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Malby & Sons, Lith.

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No. 28.—Depth, 65 Fathoms.

Distance 1,200 yards from ship.
Cup lead brought up sand and few branch alcyonoids.

No. 29.—Depth, 181 Fathoms.

Distance (not stated).
Cup lead brought up coarse coral sand.

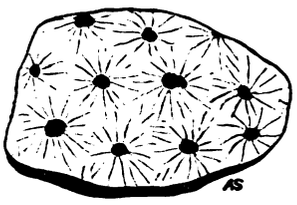
No. 30.—Depth, 25 Fathoms.

In deep channel of rim of lagoon.
Distance 820 yards from the ship, bearing S. 12 E.
Cup lead brought up sand and broken coral.
Dredge, one swab, and 50-lb. weight put down and dragged to 22 fathoms :—
Dredge came up full of coral, sand, and broken shell. Swab brought up coral rock and alcyonarians.

SECTION D.

No. 31.—Depth, 32 Fathoms.

Distance 260 yards from ship.
Cup lead brought up coarse sand and broken shell.
Dredge brought up fragments of dead coral rock evenly coated with red nullipora, dead fungidæ, simple corals, and shells.



Swab brought up one small flake of live porous brown coral,
One small flake of live coral, each polyp having green colour and radiating striæ from an elongated mouth,
And one live pteroceras, soft alcyonarians, sertularians, and algæ.

No. 32.—Depth, 46 Fathoms.

Distance 300 yards from ship.
Cup lead brought up coarse coral, sand, and broken shell.
Dredge brought up broken lumps of encrusted coral rock.

No. 33.—Depth, 65 Fathoms.

Cup lead brought up fine white sand.

No. 34.—Depth, 25 Fathoms.

Distance 200 yards from ship.
Edge of reef 11 fathoms, dredge dropped outside it into the blue water.
Cup lead brought up small coral, débris, and shell.
Dredge was full of dead coral rock, coarse sand and dead shells.
Swab brought up one thin plate of pocillapora ? several simple corals, echini, one seraphs terebellum, one olive.

No. 35.—Depth, 10¼ Fathoms.

Distance from the ship 100 yards.
One madrepore, one branching nullipora, one large asteroid, and soft alcyonarians were obtained.

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No. 36.—Depth, 247 Fathoms.

Distance 964 yards from ship.
Cup lead brought up coarse sand and gravel.

No. 37.—Depth, 218 Fathoms.

Distance 782 yards from ship.
Cup lead brought up coarse sand and broken shell.

No. 38.—Depth, 99 Fathoms.

Distance 397 yards from ship.
Cup lead brought up broken coral and a minute univalve (alive).

LAGOON.

Bearings given are Magnetic : and from the Boat.

No. 39.—Depth, 45 Fathoms.

Distance 2,170 yards from ship bearing S. 28° E.
Temperature of bottom 80°, surface 85°.
Water a deep ultramarine.
Cup lead brought up fine white sand.

Dredge came up *full* of fine greenish sand, containing large foraminifera tests.

Swab brought up 2 phorus (dead),
1 olive, ,,
3 simple corals,
1 oval fragment of live astræa polyps, of a bright emerald green.

Fine sand, under microscope, developed many different kinds of minuti foraminifera, sponge spicules, simple and compound, spined and tubercular.

No. 40.—Depth, 43 Fathoms.

1,640 yards from the ship, bearing S. 30° E.
Cup lead brought up fine white sand.

No. 41.—Depth, 41 Fathoms.

Cup lead brought up fine white sand.

SECTION E.

No. 42.—Depth, 37 Fathoms.

Distance 620 yards from ship.
Cup lead brought up fine white sand.

No. 43.—Depth, 43 Fathoms.

Distance 466 yards from ship.
Cup lead brought up coral sand.

No. 44.—Depth, 41 Fathoms.

Cup lead brought up fine white sand,

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SECTION F.

No. 45.—Depth, 26 Fathoms.

Distance 340 yards from the ship.
Cup lead brought up small dead coral fragments.
Dredge and swabs brought up broken lumps of dead coral rock,
Large branches of massive dendrophyllia, nigrescens, with living polyps in upper cups.
A large quantity of orange jointed coral of genus mopsea, and numerous sponges,
Alcyonoids and comatulæ.

No. 46.—Depth, 28 Fathoms.

Distance 360 yards from ship.
Cup lead brought up sand and small broken coral (dead).
Dredge was full of dead encrusted coral with red nullipora, few simple corals, shells, and one live chiton.

No. 47.—Depth, 35 Fathoms.

Distance 400 yards from ship.
Cup lead brought up small coral débris and sand.
Dredge brought up large fragments of encrusted coral rock in quantity, few sponges, echini and ophiuroids, simple orange-coloured coral.

No. 48.—Depth, 259 Fathoms.

Distance 1,870 yards from ship.
Cup lead brought up coarse coral sand.

No. 49.—Depth, 4 Fathoms.

Distance 189 yards from ship.
Small piece of dead coral obtained.

No. 50.—Depth, 163 Fathoms.

842 yards from ship.
Cup lead brought up coarse coral sand.

No. 51.—Depth, 198 Fathoms.

1,049 yards from the ship.
Cup lead brought up fine sand.

No. 52.—Depth, 7 Fathoms.

On rim of Itu Aba, distance 560 yards, ship bearing N. 3° W.
Bottom plainly visible, growing coral and patches of sand.
Dredge contained dead coral, several madrepores, oculinas and porites (alive).

No. 53.—Depth, 6¾ Fathoms.

Distance from ship 880 yards, bearing N. 12° E.
Dredge and swabs brought up :—
3 madrepores, 1 porite, 1 oculina, pink.

No. 54.—Depth, 32 Fathoms.

Inside the lagoon, 2,740 yards from the ship, bearing N. 82° W.
Cup lead brought up fine white sand foraminifera and shell.

No. 55.—Depth, 40 Fathoms.

Inside the lagoon, 4,940 yards from ship, bearing N. 73° W.
Cup lead brought up fine white sand and broken shell.

No. 56.—Depth, 41 Fathoms.

Inside the lagoon, 5,240 yards from ship, bearing N. 72° W.
Temperature of bottom 79¼, surface 84¼.

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Lagoon. Dredge brought up broken fragments of dead encrusted coral, covered in parts by live white or brown coral, very porous ; dead shells, sand, small echini, and simple corals (dead).

No. 57.—Depth, 40 Fathoms.

Lagoon, 4,240 yards from the ship, bearing N. 66° W.
Dredge brought up fine white sand, live sponges, asteroids, echini, small simple dead corals and shells.

No. 58.—Depth 30 Fathoms.

Outside reef, Itu Aba, 620 yards from ship, bearing, 85° E.
Cup lead brought up foraminifera, broken coral and shell.
Dredge brought up broken encrusted coral rock, sponges, and branching alcyonarians.

No. 59.—Depth, 12¾ Fathoms.

Distance 1,496 yards from the ship.
Cup lead brought up dead coral.

No. 60.—Depth, 31 Fathoms.

Distance, 2,232 yards from the ship.
Cup lead brought up dead coral and shell.

No. 61.—Depth, 26 Fathoms.

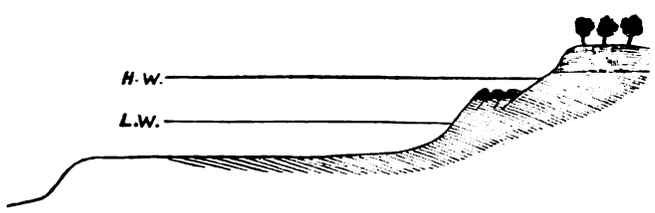
Distance, 1,928 yards from the ship.
Cup lead brought up dead coral and broken shell.

SAND CAY ISLET.

The ship was at anchor in 7 fathoms, on the outer reef ; living corals were plainly visible in beds with lanes of sand in between. A swab brought up a madrepore tree with oculinoid and three astreans attached.

The islet is now about ¼ mile across, entirely of sand, a little depressed in the centre, on it four different shrubs, (one labiate and one euphorbian), some coarse grass, a few moths, flies, ants, and one lizard (seen).

On the beach of dazzling white sand were fragments of bleached corals, chiefly madrepores and tubipores, together with large numbers of dead shells, nautilus, olives, pteroceras, naticas, &c. On the outer side were lines of coral cement running parallel to the reef and between high and low water mark, there being a steep sand slope above and below ; the topmost of these being the whitest, and softest, and looking *most recent.* The shore platform extended for about half-a-mile both to seaward and towards the lagoon, and at low water one could wade out to the very edge, where there was a rapid fall out of wading depth.



The bottom of this flat is covered by sand and dead coral, with here and there patches of growing coral, soft alcyonoids, &c.

Nearest the beach fragile madrepores and blue hydroid corals ; then astreans, green and yellow, larger madrepores and porites, and as the edge was approached beds of long horn-like madrepores, stylopors, and meandrinas, the latter generally with upper surface dead. Bright coral fish plentiful ; large holothurians and tridacnas with bright blue mantle.

On the slope beyond the breakers the coral is growing luxuriously.

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NAM YIT ISLAND.

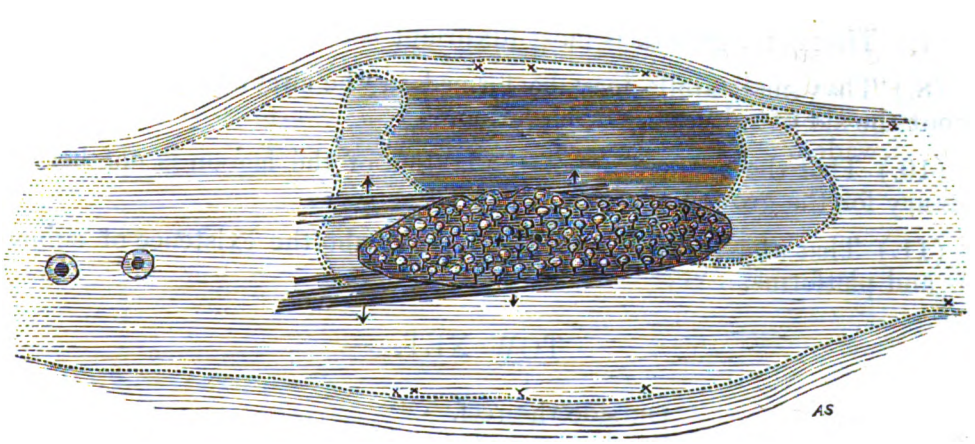
The ship anchored in 5 fathoms on the N.E. side. There is a channel of deeper water between this and the fringing reef surrounding the island which is almost entirely dead and covered by sand.

The island itself is about half a mile long, well covered by small trees and shrubs *older* than those on Sand cay, of the same kind with one or two others (specimen sent). One small moth, common (sent). The soil of the island was very brown and earthy at the surface, but below a loose oolitic rock; the highest part of the island was not more than 12 feet above high water line, and the natives (Chinese) informed me that the sea from the south breaks right over the island, but not from the north which is the lagoon side, though on that shore there were gullies cut by water into the island, destroying trees; and one large tree lay on the beach. There was a well sunk in the centre of the island 6 feet deep through *sand*.

There were several points of interest about this island.

(1.) The long parallel lines of rock with strike (so to speak) of W. by N.;—these, at the west end of the island, were most marked, dipping on either side at an angle of 15° roughly, the interval being filled by sand, and further to the west two new sand cays have formed. These lines of rock were most marked on the south or weather side (*vide* print, from photograph).

(2.) As above stated, the platform is very flat and dead, but on the north side one had to pass over a shallow ridge at the margin, and on this ridge were rocks awash at half tide; these dead rocks also showing on the edge of the reef on the south side, and on the extension of the platform east.



Shore platform.
Sand dries at low water.
0 1
Shrubs.

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(3). That at the east and west ends of the island the sand extending by a couple of horns northward with deeper water inside, so that by an extension over the shallow ridge marked by the rocks, a small lagoon would be formed; and may be an explanation of the small atolls in the circumference of larger ones, for the sand bank when once formed would easily accumulate and soon get matted together by roots of trees, as shown by Sand cay, which was bare 21 years ago.

On the outer shallow reef obtained one fungia, a few meandrinas and madrepores. Shells were abundant; nautilus, strombus, pteroceras, cypræae, murices, volutes, olives, columbella, cassis, nactica, nerita, cerethia, calyptrœa, &c.

SUMMARY OF TIZARD BANK.

(1.) That the islands are formed of sand throughout.

(2.) That the shore platform surrounding the islands is very flat, and mostly covered with sand, having scattered heads and beds of living astreans, meandrinas, madrepores, tubiporas, fungias, and hydroid corals, with numerous soft alcyonarians. At the edge of this reef the surf breaks, and corals are more numerous; the water rapidly deepening to 3 fathoms.

(3.) From here it shelves down to the margin of the rim in 9 to 13 fathoms, and on it grows the great forest of coral, being cut up by sand paths or channels.

(4.) There is a rapid drop from the edge of this reef to 20 to 30 fathoms, and on this slope, which was carefully dredged over and over again, the bottom proved to be dead, rotten coral, encrusted with red nullipora, very rich in sponges, tree and soft alcyonarians, dead simple corals, with algæ star fish, and urchins; but occasionally fragments of living coral were brought up. But seeing the quantity of dead rock brought up so plentifully, it is impossible to imagine that there can be much alive on this slope; *the growing coral thus building on its own talus.*

(5.) A dredging taken in the centre of one of the channels through the rim resulted in finding coarse and fine coral sand and no live corals.

(6.) At the deepest part of the lagoon, 45 fathoms, the bottom showed fine greenish sand, but with this was brought up *a living astrean*, the polyps being of a fine emerald green colour. "This fact proves that the fine sand of the lagoon is not necessarily fatal to the solid reef building astrean, and helps to explain how individual coral heads appear in the deep waters of these atolls," but it cannot be doubted that their growth is very limited.

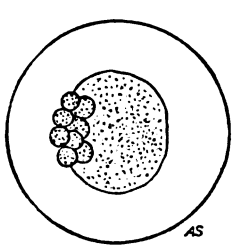
(7.) That coral growth is most luxuriant between 2 and 12 fathoms.

(8.) That small atolls may be formed in the circumference of large ones without the aid of subsidence or elevation.

(10.) That the temperature of the bottom of the lagoon is not below that necessary for the growth of corals.

(11.) That the sections prove without doubt the existence of submarine cliffs and platforms.

TOW NET.



Outside the reef.

Small crustacæ, globigerinæ, sagittæ, and noctilucæ, the most abundant hauls being taken at D and F, at the latter station were enormous numbers of minute brown solid globules floating on the surface; no pseudopoda observed, ?cymbalopora bulloides (Brady) mentioned as found in coral areas, in the "Challenger" reports.

Inside the lagoon.

Enormous numbers of sagitta, with small crustaceæ and radiolarians.

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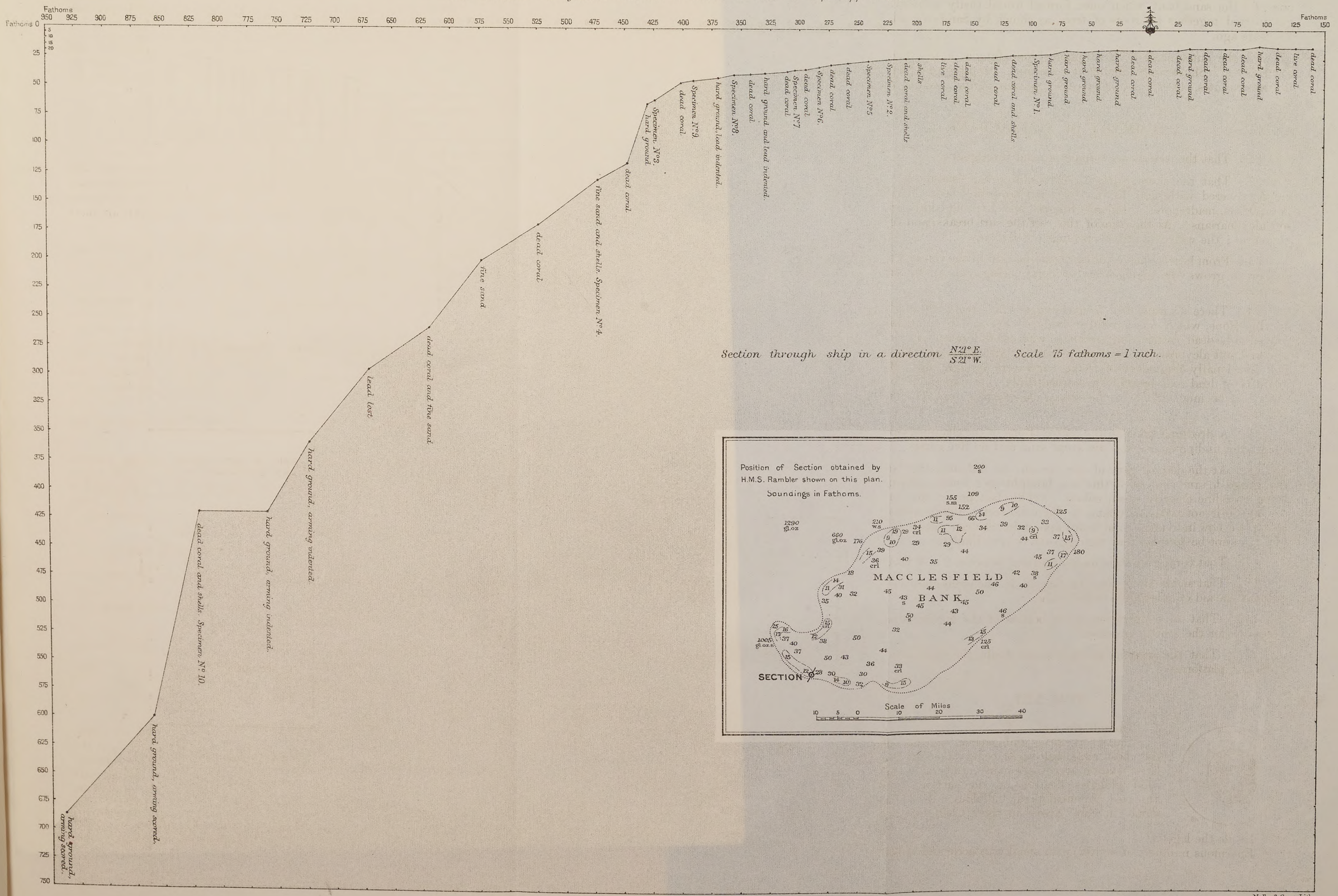
MACCLESFIELD BANK.

SECTION.

The nature of the bottom as given on this section is from the actual material brought up by the sounding lead.

For description of general condition of surface of reef, see Report pp. 6 and 17.



Section through ship in a direction $\frac{N21°E.}{S21°W.}$ *Scale 75 fathoms = 1 inch.*

Position of Section obtained by H.M.S. Rambler shown on this plan.
Soundings in Fathoms.
MACCLESFIELD BANK
SECTION
Scale of Miles
10 5 0 10 20 30 40

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MACCLESFIELD BANK.

On the 23rd of April H.M.S. "Rambler" anchored on the south-west side of this reef in 13 fathoms, the lead line bringing up living coral.

The dredge was hauled seven times, in depths varying from 20 to 44 fathoms, and every time living coral was brought up, but these deep water corals were quite different to those obtained on the Tizard bank, except one cladocora? in 26 fathoms. There were two chief kinds, one a compound coral in the shape of thin cups, the other a branching *very porous* coral, with large black polyps in deep cups, both entirely unable to stand any great surf action. Life in the shape of sponges, alcyonarians, hydroids, etc., was most abundant. Between 22 and 25 fathoms the greatest numbers of coral were obtained.

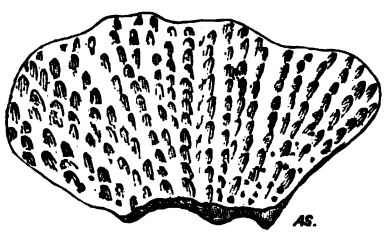
The result of the day's work impressing upon me that life on the Macclesfield bank was very active, it being very far from the condition of a *drowned atoll*. The water was full of glittering animalculæ, the surface covered by a yellow scum and numerous species of physalia floating about.

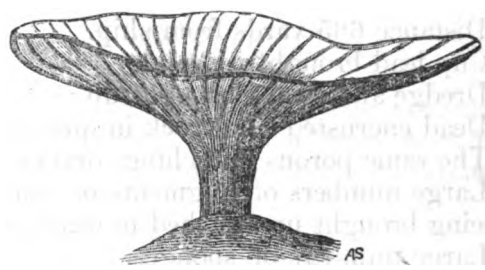
No. 1.—Depth, 20½ Fathoms.

Distance from the ship 200 yards.

Cup lead brought up sand and dead broken coral.

Dredge and swabs, both filled with live coral, three madrepores, one oculina, three kinds of thin compound cup coral, having lines of tubercles radiating to the centre, the aperture of polyp facing outwards; the colour of the polyp varying,





there being one red, one yellow, and one blue. On the under surface of these fragments were yellow and blue simple corals, large quantities of sponges, hydroids, comatulas, ophiuroids, and crabs.

No. 2.—Depth, 26½ Fathoms.

Distance from the ship 395 yards.

Dredge and swabs came up full of live coral.

One beautiful specimen of fragile branching kind with terminal polyp, cladocora,

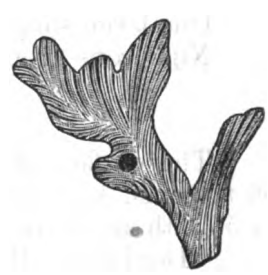
Four other branch corals,

Three cup corals, as in No. 1,

One cup coral (alive),

Numerous simple corals, alive and dead, echini and asterordei abundant, but very few soft alcyonarians.

Inside the dredge were a few lumps of encrusted rotten coral débris.



No. 3.—Depth, 61 Fathoms.

Distance from the ship 740 yards.

Cup lead brought up fine sand and small pieces of encrusted coral.

No. 4.—Depth, 130 Fathoms.

Distance from the ship 946 yards.

Cup lead brought up fine sand.

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No. 5.—Depth, 27 Fathoms.

Distance 420 yards from ship.
Dredge brought up blocks of encrusted coral rock.
Swabs, number of branches of a very loose spongy coral, with large black polyps, tops of branching yellow nullipora, alive, two large star fish, numbers of sea urchins with long and short spines, pink coloured sea mats and algæ.

No. 6.—Depth, 32 Fathoms.

Distance 520 yards from ship.
Cup lead brought up coarse sand and shell.
Dredge full of coral débris, coated with thick red leathery nullipora, one piece of porites ? alive, several pieces of branched coral (as No. 5), small hairy crabs, several urchins and algæ, green and red.

No. 7.—Depth, 35 Fathoms.

Distance 600 yards from ship.
Cup lead brought up sand.
Dredge and swabs brought up :—
Large quantity of coral encrusted rock,
Live coral as in No. 6 (few),
Quantities of sponges.

No. 8.—Depth, 40 Fathoms.

Distance 665 yards from ship.
Cup lead brought up sand.
Dredge and swabs brought up :—
Dead encrusted coral rock in quantities,
The same porous branching coral as in No. 5, alive, still plentiful,
Large numbers of fragments of compound cup coral, as No. 1, the base of one being brought up attached to dead rock,
Large numbers of sponges.

No. 9.—Depth, 44 Fathoms.

Distance 760 yards from ship.
Dredge and swabs with 112-lb. weight.
Cup lead brought up sand.
Dredge brought up lumps of dead encrusted coral rock, two pieces with coating of *live* porites, one small piece of spongy coral (alive),
One large simple coral,
Numerous sponges.

The surface of the Macclesfield Bank appears to shelve slowly down to 50 fathoms, here the rapid drop occurs, and from the evidence of the cup lead in 55 fathoms, it is probably like the other slopes examined.

"Dead Coral Rock" on which the live is growing, the most active being found down to 27 fathoms, and from this depth down to 44 fathoms, the deepest dredged in, and nearest the edge of the reef, the proportion of dead coral rock progressively increases.

The yellow scum on the water showed as small bundles of fibres with oblong joints, algæ.

On a piece of yellow floating weed were many nudibranchs, and cirripedæ, and also one small shrimp exactly like the weed.

The tow net was full of small crustaceæ, a few pelagic for aminiferæ and quantities of noctiluca.

In no place is the wonderful resemblance between organisms and their surroundings more marked than in coral areas. The blue colour of oceanic pelagic species I have already mentioned. The absolute likeness of shrimps

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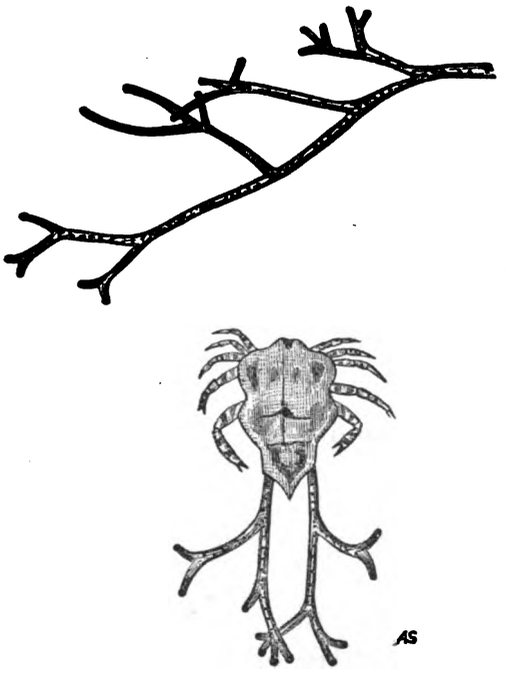
to the weed in which they live, and of the small coloured crabs in the tinted corals to weed being most perfect.

The following is a very good instance of the latter (specimen sent), unfortunately the spirit removes all the colour.*



Crab and Algæ found on Tizard Bank.

It was obtained in shallow water, more or less hidden by the calcareous weed, from which it rarely moved, the branched antennæ were waved by movement of the cephalic joint, up and down in imitation of the movement of the weed.

The sketch represents the crab and a branch as alive.

P. W. BASSETT-SMITH,

Surgeon.

Captain W. J. L. Wharton, R.N., F.R.S.

* In the original drawing the colour both of the crab and weed is pink, interspersed with faint yellow, the termini of the branches of the weed and antennæ of crab being of a darker shade of pink.

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